

NARROW GAUGE
RAILWAYS;

A PROPOSAL FOR THEIR ADOPTION

AS A MEANS OF EXTENDING

The Railway System of New Brunswick

AT A REDUCED COST.

BY

J. EDWARD BOYD, C. E.

ST. JOHN, N. B. :
WILLIAM M. WRIGHT,
21, PRINCE WILLIAM STREET.

1865.

It
of a
acce
for t
ficia
been
ques
in th
of th
fitted
The
case
the
viou
an e
of a
incr
pop
grea
mat
Rai
arie
B
and
ther
thes
can
cour

NARROW GAUGE RAILWAYS.

It is generally acknowledged that the advance of a nation in material prosperity may be much accelerated by increasing the facilities for travel and for the transportation of merchandize. The beneficial effects of the introduction of Railways has been too well proved by experience to admit of any question, or to require at this time any arguments in their favour. They have been found in all parts of the world to be a means of transport eminently fitted to meet the general wants of communities. The building of a Railway has been in almost all cases followed by an increase in the value of property, the opening of a market for produce which was previously excluded by the expense of transportation, an extension of manufactures, a decrease in the cost of all descriptions of goods to consumers, and an increased consumption caused by the accession to the population. Add to these the saving of time, the greater comfort of travel, and the spread of information by the freer interchange of thought, and Railways may with propriety be called the "missionaries of civilization."

But the expense involved in the construction and operation of Railways has hitherto rendered them formidable undertakings, more particularly in these provinces, where the amount of capital which can be withdrawn from the ordinary business of the country is small, and the returns to be expected

necessarily limited, by the sparseness of the population. The numerous projects which have, from time to time, been set on foot in New Brunswick shew that the people are by no means indifferent to the principle of progression, and that the need of some improved means of transport is severely felt. That so many of these schemes have proved abortive, is due not so much to any lack of enterprize, as to a want of the necessary capital. Any proposition, therefore, which will have a tendency to remove this bar to our progress, by a reduction in the first cost of the works, will, it is presumed, meet with favourable consideration. The extension of the benefits of Railway communication to all parts of the province by a judicious adaptation of the means at our disposal, must be a matter of interest to everyone. There should be a Railway suitable for every country and each district, the class of road adopted being regulated by, and dependent on, the wants and resources of the country through which it is to pass.

The cost of a Railway is, all other conditions being similar, controlled to a great extent by the guage. The guage of 5ft. 6in., in use in this province, is rather less than a mean between the English broad and narrow guages. It has been adopted, likewise, in India, Canada, Spain, Portugal, Brazil, Chili, and other countries, where the Railways were constructed after an opportunity had been afforded in England of testing and thoroughly discussing the respective merits of the different guages. It is, therefore, at least, fair to suppose that experience had shewn this to be the best guage for a national system of Railways. But assuming the fitness of the 5ft. 6in. guage for the trunk line and its more important

bra
bra
line
be i
whi
I
to c
the
por
mot
pas
key
bot
ten
can
resi
the
gua
100
van
ove
rad
tro
resi
out
trib
line
sive
T
a d
fro
of t
be
the

branches, it by no means follows that for lesser branches, or rather tributary lines, and independent lines in country districts, a narrower guage might not be introduced with advantage. The width of guage which I propose for such lines is three feet.

It is now well understood that the resistance due to curves and imperfections in the track decreases as the width between the rails is reduced. The greater portion of curve resistance is due to the sliding motion produced by the difference of the space passed over by two wheels of the same diameter keyed fast to opposite ends of an axle common to both. Inequalities in the surface give the wheels a tendency to bind diagonally across the track. It can, therefore, be easily conceived that both these resistances increase or diminish with the length of the axle—or what is the same thing, the width of guage. An engine of 5ft. 6in. guage, on a curve of 1000 feet radius, would consequently have little advantage, as far as this loss of power is concerned, over one of 3 feet guage on a curve of half that radius. As sharper curves could, therefore, be introduced, without a corresponding increase in the resistance, heavy earthworks could be avoided without a resort to steep gradients, and the narrow guage tributaries could be carried into many districts where lines of the wider guage would be enormously expensive, in both construction and operation.

This reduction of the guage would be followed by a diminution in the cost of every part of the work, from the “turning of the first sod,” to the “driving of the last spike.” The quantity of earthwork would be decreased in an average country, even assuming the same curves and gradients, by from 25 to 33 per

cent.; but it is fair to assume a saving of 50 per cent. in earthwork, because, as has been shewn, the line could, by the use of sharper curves, be better fitted to the natural surface than one of the 5ft. 6in. guage. In masonry the saving would be at least 25 per cent. The engines would weigh from 12 to 14 tons, instead of 28 tons; and the weight of the rails, chairs, &c., being proportionately less, the cost of permanent way would be about one half. A corresponding reduction in the cost of the rolling stock would naturally follow.

There is no reason why a line of this description should not serve as good a purpose in many districts of this and the neighbouring provinces, as one constructed on a wider guage at twice the expense. A trunk line requires to be of the most permanent and substantial description, because an interruption to the traffic would be a serious inconvenience, which must be guarded against at any cost. The tributary and less important lines, on the other hand, can be more economically constructed, by less original outlay, and more frequent renewals. Cases are of constant recurrence where the question between an expensive and an economical construction is one upon which the financial practicability of a proposed line entirely depends. A district may have the means of building a Railway at the rate of \$15,000 per mile, when one of double that cost would be totally out of the question. It is extremely doubtful if the first cost of a line has the least effect on the future traffic; and a line may, at a very cheap rate, be made capable of conducting a large amount of business with perfect safety. And it should be borne in mind that a traf-

fic
wo
siv
ties
des
cer
tha
a s
the
vin
bee
T
ger
hav
Por
whi
was
loc
ing
add
to
eng
tho
and
est
gra
of t
one
fity
of t
of
bee

*Th
neer

fic which would yield a fair profit on a cheap line would barely pay the interest on the cost of an expensive one. It is not necessary to enumerate the localities to which these lines might be applied, nor is it desirable to enter here into details which must, to a certain extent, vary with varying circumstances. All that is sought at present is to lay before the public a system which I believe to be admirably suited to the wants and resources of many parts of the provinces. That it can be successfully carried out, has been proved by experience in other countries.

The Railway of narrowest guage used for passenger traffic, and worked by locomotives, (of which I have seen any account), is one from Festiniog to Port Madoc, in Merionithshire, Wales, the guage of which is two feet.* This line was built in 1832, but was worked by horses until June 1863, when two locomotives were placed upon it, and these working successfully, two others were subsequently added. These four engines had run 57,000 miles up to February 1865, without leaving the rails. The engines are four-wheeled tank engines, similar to those commonly known as "contractor's engines," and certainly not of the best description. The heaviest weighs $7\frac{1}{2}$ tons in working order. The average gradient is one in 92 for $12\frac{1}{4}$ miles, the total length of the line being 13 miles, the steepest gradient is one in 60. Up these the engines can take a load of fifty tons, exclusive of their own weight, at the rate of ten miles an hour. There were curves on the line of 132ft., 198ft., and 264ft. radius, but these have been latterly somewhat improved.

*The description is abridged from a paper read before the Institute of Civil Engineers, by Capt. Tyler, R. E.

In the colliery and iron districts of England and Wales there are lines of 2ft. 4in., and 2ft. 8in. gauge; and locomotives are used in Staffordshire and the North country iron districts on lines of 2ft. 6in. and 3ft. gauge with great success.

The Norwegian government have in operation two lines of 3ft. 6in. gauge, the aggregate length of which is fifty-four miles. One of these has gradients of 1 in 70, and curves of 1000 feet radius; and the other, through a more difficult country, gradients of 1 in 42, and curves of 700 feet radius. The engines weigh 14 tons in steam, and the ordinary average speed is about 15 miles an hour, including stoppages. A further length of fifty-six miles is in course of construction, and no other gauge is contemplated for the Railways of that country. A gauge of 3ft. 9in. has been successfully worked in Belgium.

There can, therefore, be no doubt as to the practicability of working with advantage such lines as I propose. The gauge is quite wide enough to allow of the construction of engines of considerable power, while any narrower gauge would not admit of the arrangement of carriages used in this country. Passenger trains could be run at the rate of 15 or 20 miles an hour,—a speed great enough to satisfy all reasonable demands. The passenger carriages might be made seven feet six inches wide inside, which would give ample room for comfortable seats. A less width would answer for the freight cars. And there need not be any apprehensions as to the steadiness of the carriages even on the sharpest curves. Mr. Gooch has mentioned that a carriage was once driven at the rate of 40 miles an hour round a curve of 600ft. radius at Bristol. The motion was steady,

without the least appearance of a disposition to overturn. This was, it is true, on the 7ft. gauge, but the speed was much greater than would ever be required on the lines in question. Mr. Bidder has estimated that on the 4ft. 8½in. gauge, with a curve of half a mile radius, a speed of 130 miles an hour might be attained before the centrifugal force would overcome the gravity of a carriage and throw it off.

The objection will no doubt be made that the proposed plan would be the means of introducing here the "break of gauge" which causes so much inconvenience in the United States, but that argument has little weight in the present case because the lines would not be parts of a great national system of through lines. With our limited quantity of traffic, the inconvenience would be small, and might be almost altogether removed by proper arrangements at the junction. I have no wish to underrate the advantages of a uniform gauge, easy curves, and gradients, and all the other characteristics of a first class Railway, but these, however desirable, are in some cases unattainable, except at a cost which puts them altogether beyond our reach.

The 3ft. lines are proposed only for districts which at present have not the means to construct lines of the ordinary gauge, or where the traffic to be expected will not justify so great an expenditure, and where the people are consequently shut out from all Railway connections. The same objections which may be made to this scheme, if carried a little further, would deprive many important localities of all highway communication, unless they could have roads constructed under the best system of road engineering.

These narrow gauge Railways, constructed at a low cost, with light rails, wooden bridges, and cheap stations, with everything neat and substantial, but with no unnecessary finish, would undoubtedly afford all the accommodation that is needed for many years to come. Should the people, when it became necessary to renew the superstructure, feel themselves competent to bear the expense of increasing the gauge to that of the trunk line, they could easily do so, not forgetting at the same time, to give all due credit to the little line, which, by developing the resources of their district, had so materially increased their wealth as to enable them to make the improvement.

S
I ha
of t
the
186
gua
it, o
M
"
" po
" as
" ar
" a
" ha
H
" tra
" da
" wa
lt
" pu
" bil
" be
" re
" an
M
be e
obst
supp
"
" gu
" ga
" W
" by
"
" ar
"
" ch
" pa
" ra
*D
on t
N. S.

APPENDIX.

SINCE the foregoing pages were placed in the hands of the publisher, I have met with a report submitted by Mr. Fitzgibbon, Chief Engineer of the Southern and Western Railway, in Queensland, Australia, to the Government of that colony. This report, which is dated July 31st, 1865, bears out so fully all that I have said of the economy of narrow guage Railways, that I cannot do better than append some extracts from it, omitting such paragraphs as have a purely local interest.

Mr. Fitzgibbon says :—

“After a careful examination of the country through which the proposed lines were to pass, and after having collected much information as to the existing and prospective traffic to be carried upon them, I arrived at the conclusion that to meet every requirement of the case, a single line of railway, with proper sidings and passing places, and having a guage of 3 ft. 6 in., would be sufficient.”

He estimates that such a line of Railway will “fully accommodate a traffic of 200 tons of goods, and 400 passengers, in one direction, each day of 12 hours; or, of 400 tons of goods, and 800 passengers, both ways.”*

It appears that already a section of this Railway is “open for the public traffic; and it is placed beyond doubt, that in carrying capabilities for goods and passengers, and in other essential points, it fully bears out the statements contained in ‘a former report’; while as regards the quality and durability of the works, of the rolling stock, and of the equipment of the line, nothing is left to be desired.”

Mr. Fitzgibbon then describes some of the engineering difficulties to be encountered. The country, it seems, presents many serious natural obstacles to the construction of railways, besides which it is difficult to supply labour and materials, and the rate of wages is very high.

“It has been alleged by opponents to any reduction of the railway guage below 4 ft. 8½ ins., such as that existing on the English narrow guage system, and copied in the adjoining colony of New South Wales, that no material saving in the cost of railways can be effected by the adoption of a guage of 3 ft. 6 ins., worked at low speeds.”

“In contravention, however, of this allegation, the following facts are submitted” :—

“The minimum radius of curves on our 3 ft. 6 in. guage lines is five chains, and it is found that the resistance offered by such curves to passing trains, is about the same as on curves of seven or eight chains radius, on a 4 ft. 8½ ins. guage line.”

*During the nine months ending the 30th September, 1864, the average daily traffic on the E. & N. A. Railway was 484 passengers, and 185 tons of freight, and on the N. S. Railway, during the same period, 400 passengers and 180 tons of freight.

"On twenty-two miles of our line, where it passes over the Little Liverpool and Main Ranges, numerous curves of five chains radius are introduced, in order to avoid the heavy works in excavation, tunnelling, viaducts, &c., which the use of curves of a larger radius would involve; but had a gauge of 4 ft. 8½ ins. been adopted, curves of eight chains radius, (as used in crossing the Blue Mountains in New South Wales), would have been necessary; and it was found, on a calculation of the quantities of work, that the cost of the line with 4 ft. 8½ ins. gauge, would exceed that of the 3 ft. 6 ins. gauge by more than threefold."

"Taking the item of permanent way, we find that on the New South Wales lines the cost per mile is £2,996 7s. 6d. : while on our 3 ft. 6 in. gauge lines, the cost is £2,162 4s. 0d. per mile, including broken stone ballast, giving a difference of £834 per mile in favor of the narrow gauge."

A statement which is appended to the report, shews that, taking an equal quantity of rolling stock on each line, the cost of that on the 3 ft. 6 in. gauge, is 64½ per cent. of the cost on the 4 ft. 8½ in. gauge.

It appears that a speed of over twenty miles an hour has been attained on the 3 ft. 6 in. line, "without any perceptible oscillation or unsteadiness of the carriages, which are roomy and comfortable, and give the greatest satisfaction to the public."

Mr. Fitzgibbon maintains that it is the wisest policy "to provide only for the wants we now foresee, and to carry out effectually a system of railways which is within our present means, leaving posterity to decide what further expenditure should be incurred to meet its wants."

"If it had been determined to adopt a gauge of 4 ft. 8½ ins. in this colony, the result would have been that the construction of railways of sufficient length to effectually open up the back country must have been postponed indefinitely, and the progress of the country held back in like degree."

"When what we have now provided proves to be unequal in power to the undeveloped wants of the future, it may also prove that all the systems from which we have now to choose, have been superseded by the advancement of science."

"Again, to expend two or three times the necessary amount now, with a view to meeting a want which cannot be felt for perhaps twenty years or more, is simply to expend in interest alone a sum sufficient to rebuild an entirely new system of communication."

"The position in which this colony is placed by the adoption of the 3 ft. 6 in. gauge, instead of the 4 ft. 8½ ins., may be shortly summed up thus":—

"The advantages are, that the colony will be provided with internal communication at a much earlier period than it could otherwise have been, and at a cost which it can afford, instead of having these

"advantages postponed *sine die*. It will be burdened with a very much smaller debt than it would otherwise have had to incur, while its means for carrying the necessary traffic will be ample for many years to come."

"The disadvantages are, that the low power of the machinery employed will limit the speed at which the traffic is to be carried, and the quantity to be conveyed in a given time. But if the power should prove sufficient for the present and the future wants of the community during a reasonable number of years, (of which there is no doubt,) the objects in view will be fully attained. The construction of the road, and the various appliances employed, are in all respects equal to any railway in the world, excepting only that they are limited in power to the wants of the case."

"Queensland commenced railway construction in 1864, and by the end of this year will have 40 miles open, 180 miles in progress of construction, and 250 miles more under survey."

Views similar to the foregoing were advocated by a writer in the London "*Engineer*" in April last, except that he recommends 2 ft. 6 in. as being the best gauge.

Mr. Fitzgibbon, as will be seen, prefers a gauge of 3 ft. 6 in., but I have very good reason for believing that, for lines in the rural districts of this province, the gauge of 3 feet is wide enough to answer every requirement. A broader gauge would only add to the expense without giving any equivalent advantage.

If the saving effected by a reduction of the gauge from 4 ft. 8½ ins., to 3 ft. 6 in., is so great, the difference between the cost of a 5 ft. 6 in. line and one of 3 feet is certainly not *over* estimated at 50 per cent.